

THE GENERIC SIGNIFICANCE OF THE BUCCAL  
INFRACILIATURE IN THE FAMILY  
TETRAHYMENIDAE AND A PROPOSED  
NEW GENUS AND SPECIES,  
**PARATETRAHYMENA WASSI**<sup>1</sup>

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The hymenostome holotrich family Tetrahymenidae was erected by Corliss (1952) to relieve, in part, the heterogeneity of Kahl's (1930-1935) family Frontoniidae. It was characterized chiefly by a tetrahymenal buccal apparatus consisting of an undulating membrane on the right edge of the buccal cavity and three membranelles which occupied the floor and left wall of the oral cavity. At that time the following genera were included as unquestionable members of the family: *Tetrahymena*, *Colpidium*, *Glaucoma*, *Deltopylum*, and *Loxocephalus*. Three other genera, *Monochilum*, *Dichilum*, and *Lambornella*, were considered as likely candidates. Stout (1956) rediscovered and added the genus *Sathrophilus* Corliss, 1960 (= *Saprophilus* Stokes, 1887) which Corliss (1952) considered as an involved genus. Later Corliss (1961), in listing again the genera of the family, included *Tetrahymena*, *Sathrophilus*, *Loxocephalus*, *Colpidium*, *Glaucoma*, *Deltopylum*, *Dichilum*, *Monochilum*, and *Stegochilum*. An additional genus, *Platymematum* has since been added by Borror (1962).

It is the purpose of this paper to review the genera of the family Tetrahymenidae, with particular emphasis on the buccal infraciliature, and to propose the addition of a new genus, *Paratetrahymena*, to this family.

#### MATERIALS AND METHODS

The ciliate being described as a new genus and species appeared in a culture made from bottom sediment collected in the York River, near the Virginia Institute of Marine Science at Gloucester Point, Virginia. Clonal

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cultures of this brackish-water ciliate were established in a medium consisting of autoclaved river water and *Ulva* (sea lettuce). Phase microscopical observations were made on the living organisms and light microscopical studies were made on animals stained by the Chatton-Lwoff method of silver impregnation (Corliss 1953b). Nuclear preparations were stained with haematoxylin.

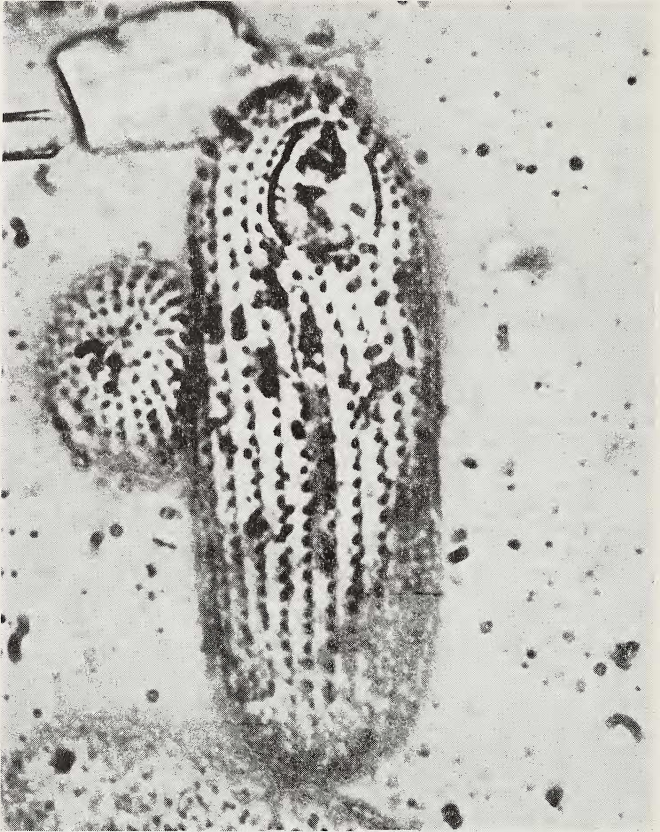
Morphology of *Paratetrahymena wassi* n.g., n. sp.<sup>2</sup>

*Body Form and Size.* The body is generally elongated with a rounded posterior and bluntly pointed anterior end. The body is very flexible and in mass cultures the ciliates commonly assemble in clusters on the bottom of the petri dish to feed. While feeding, the anterior end moves in a series of short quick movements. The average size of 70 silver impregnated animals was 55.8 x 22.2 micra. The animals generally seem more elongated in the living cultures, so apparently there is some shortening at fixation. The age of the cultures also seems to influence the length-width ratio. In older, well-fed cultures, the animals appeared wider than in younger dividing ones.

*Ciliary Meridians.* The number of ciliary meridians vary from 22-26 and are rather evenly spaced. The second meridian (the meridians are numbered clockwise, following convention, (see Corliss, 1953a) continues anteriorly around the right side (animal's right) of the buccal cavity and ends just in front of the anterior edge of membranelle one (Fig. 1). In silver impregnated animals, the anterior end of this meridian consists of about 7-9 granules more closely set than the remaining granules of the meridian. Meridian number one and the last two meridians terminate posterior to the buccal cavity (Fig. 1). The third from the last meridian (N-2) runs around the left side of the buccal cavity and ends near the posterior end of membranelle one. In silver impregnated animals, this meridian, from about the level of the posterior end of the buccal cavity, consists of about 12-17 closely set granules (Fig. 2). In living animals these granules were observed to possess cilia, but these cilia did not seem to function as a membrane. All the remaining meridians continue anteriorly and end to form a rather clear loop-shaped area. Occasionally, a silver stained granule or two are present within this area. The basal granule complexes of the anterior ends of the meridian are closer together. Posteriorly the meridians end irregularly at the caudal pole. A caudal cilium is present, its infraciliature represented by a polar basal granule-complex (Holz and Corliss, 1956).

The generic name *Paratetrahymena* was chosen for this ciliate because of its general similarity to the genus *Tetrahymena*. The specific name *wassi* was chosen to honor Dr. Arvin L. Wass of the Virginia Institute of Marine Science who supplied the original culture from which this ciliate was isolated.

*Buccal Cavity and Buccal Apparatus.* The buccal cavity is broadly pyriform to oval in shape and located very near the anterior end (Fig. 2) It



EXPLANATION OF FIGURE I

*Paratetrahymena wassi.* Ventral view of silver impregnated animal.



FIGURE 2



FIGURE 3

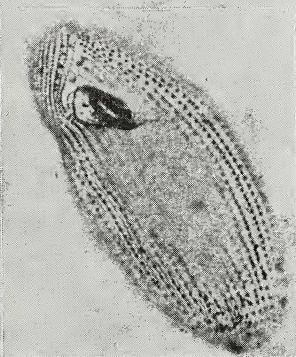


FIGURE 4



FIGURE 5

EXPLANATION OF FIGURES 2, 3, 4, 5.

Ventral views of silver impregnated animals. Fig. 2. *Paratetrahymena wassi*. Fig. 3. *Tetrahymena*. Fig. 4. *Colpidium*. Fig. 5. *Glaucoma*.



measures about  $11.0 \times 8.5$  micra. It is very shallow anteriorly and deepens posteriorly. The undulating membrane (UM) measures about 8.9 micra and runs along the right side of the buccal cavity. It terminates opposite the anterior end of membranelle number two. In silver impregnated specimens it appears as closely set row of granules (Fig. 2). A few scattered granules are present along the posterior edge of the buccal cavity but it is not clear whether these are a part of the UM or just granules of the three post-oral meridians. The so-called UM striations (Corliss, 1953a) run down into the buccal cavity. These begin about opposite membranelle three and continue around and along the posterior edge. Three membranelles occupy the floor of the buccal cavity and extend upon the right wall close to the UM (Fig. 2). Membranelle one ( $M_1$ ) and membranelle two ( $M_2$ ) are present in the anterior half of the buccal cavity while membranelle three ( $M_3$ ) lies near or posterior to the center.  $M_1$  is irregularly rectangular in shape and measures approximately  $3.6 \times 1.6$  micra. The anterior end seems to be wider.  $M_2$  is irregular elongated with a short posteriorly directed bar from the anterior end. It measures  $3.4 \times 1.2$  micra and seems to be somewhat pointed near the posterior end.  $M_3$  measures  $2.2 \times .9$  micra and is irregularly triangular in shape. It is located very near the cytostome.

*Contractile Vacuole Pore.* A single CVP is located near the posterior end and is associated with the end of the third ciliary meridian.

*Cytoproct.* The very short CYP is located very near the posterior end and is associated with the middle post-oral meridian.

*Nuclear Components.* Both a macronucleus and micronucleus are present and located either near the center or in the anterior end. The micronucleus is either near or embedded in the macronucleus which is spherical to ovoid in shape. The macronucleus measures 5.2 micra.

*Paratetrahymena wassi* is established as type-species of the new genus, by monotypy. Two silver impregnation preparations, one designated as containing the holotype and the other containing paratypes, have been deposited in the International Collection for ciliate Type-Specimens, a repository under the jurisdiction of the Museum of Natural History of the University of Illinois (see Corliss, 1963). Additional syntype slides remain in the collection of the author.

## DISCUSSION

The family Tetrahymenidae Corliss (1952) the most recent family erected in the order Hymenostomatida, was established after the discovery of techniques which made possible a precise description of the simple tetrahymenal buccal apparatus found in such hymenostome ciliates. It should,



FIGURE 6



FIGURE 7



FIGURE 8



FIGURE 9

## EXPLANATION OF FIGURES 6, 7, 8, 9.

Ventral views of silver impregnated animals. Fig. 6. *Sathrophilus*. Fig. 7. *Loxocephalus*. Fig. 8. *Deltopylum* (photograph of the drawing in the original paper). Fig. 9. *Cinetochilum*.

therefore, include no genus whose buccal structures are not fully known to agree with those characterizing the family. This presently does not seem to be the case. The buccal structures of only the genera *Tetrahymena*, *Colpidium*, *Deltopylum*, *Glaucoma*, *Loxocephalus*, and *Sathrophilus* are well enough described in the literature published to date to warrant definite assignment to this family. This means that the remaining genera *Dichilum*, *Monochilum*, *Stegochilum*, included in the family by Corliss (1961), and *Platynematum*, added by Borror (1962), cannot be assigned here at the present time, in the opinion of the writer.

Many workers have contributed to the understanding of the tetrahymenal buccal apparatus of several genera assigned to the family Tetrahymenidae. The most important workers and their papers include the following: *Tetrahymena* (Fig. 3), Furgason (1940), Kozloff (1946), Corliss (1953a); *Colpidium* (Fig. 4), Gelei and Horvath (1931), Furgason (1940), Corliss (1953a); *Glaucoma* (Fig. 5), Chatton and Brachon (1935), J. Gelei (1935), Furgason (1940), Corliss (1954); *Sathrophilus* (Fig. 6), Stout (1956), Thompson and Cone (1962); *Loxocephalus* (Fig. 7), J. Gelei (1940); and *Deltopylum* (Fig. 8), Faure-Fremiet and Mugard (1946).

The present author should like to present evidence to support the assignment of two additional genera, *Paratetrahymena* and *Cinetochilum*, to the family Tetrahymenidae. The present description of *Paratetrahymena wassi* shows a tetrahymenal buccal apparatus which is recognizably different from those described for other genera. A serious attempt was made by the author to make *Paratetrahymena* co-generic with one of the unassigned genera (see Corliss, 1961) in the order Hymenostomatida, but it was not possible to do so. The genus *Cinetochilum* (Fig. 9) was considered by Corliss (1961) to belong in a separate family Cinetochilidae Perty, 1852, but studies made by G. Gelei (1940), Klein (1942), and the present author (unpublished) show clearly a tetrahymenal buccal apparatus characteristic of the family Tetrahymenidae.

The genera of Schewiakoff (1889 and 1893), *Dichilum*, *Monochilum*, and *Stegochilum*, were not originally described as possessing membraneous buccal structures of a tetrahymenal nature. In view of the fact that proper techniques were not available in Schewiakoff's time we cannot be certain whether or not these three genera may be members of the family Tetrahymenidae. Only rediscovery and redescription will determine this. As presently described, therefore, it seems unwise to include them as members of this family.

The genus *Platynematum* was placed in the family Tetrahymenidae by Borror because "it possesses tetrahymenal buccal apparatus" (Borror, 1962, p. 345). Unfortunately no description or figures were published in sup-

port of this claim. Thus it seems that *Platynematum* should not be placed among the genera of this family until a full description has been published.

It is evident, as may be seen in careful examination of Figs. 1-9, that there are generic differences in the buccal infraciliature of the various genera of the family Tetrahymenidae. Although the infraciliature is similar (the family characteristic), careful study of the position, shape, and size of the buccal cavity and of the infraciliature of the undulating membrane and of the membranelles allows unique characterization of each genus within the family. Thus generic assignment can be made in the family Tetrahymenidae on the basis of the buccal infraciliature alone and, indeed, even more important, generic assignment cannot be made at all without a proper understanding of these essential taxonomic structures.

### SUMMARY

The hymenostome holotrich family Tetrahymenidae is reviewed in light of modern techniques. It now includes only those genera which show the typical tetrahymenal buccal apparatus as described for this family. Four formerly assigned genera are omitted and two additional genera are included. A new genus and species, *Paratetrahymena wassi*, is described as a new member of this family.

### LITERATURE CITED

- Borror, A. C. 1962. Ciliated Protozoa of the Gulf of Mexico. *Bull. of Marine Sci. of the Gulf and Caribbean* 12:333-349.
- Chatton, E. & S. Brachon. 1935. Discrimination, chez deux infusoires du genre *Glaucoma*, entre système argentophile et infraciliature. *C. R. Soc. Biol. Paris*, 118:399-403.
- Corliss, J. O. 1952. Characterization of the family Tetrahymenidae nov. fam. (Abstr.) *Proc. Soc. Protozool.* 3:4.
- Corliss, J. O. 1953a. Comparative studies on holotrichous ciliates in the *Colpidium-Glaucoma-Leucophrys-Tetrahymena* group. II. Morphology, life cycles, and systematic status of strains in pure culture. *Parasitology* 43:49-87.
- Corliss, J. O. 1953b. Silver impregnation of ciliated protozoa by the Chatton-Lwoff technic. *Stain Tech.* 28:97-100.
- Corliss, J. O. 1954. The buccal apparatus and systematic status of *Glaucoma frontata*. ("Dallsia frontata" Stokes). *J. Morph.* 94:199-220.
- Corliss, J. O. 1961. The Ciliated Protozoa: Characterization, Classifi-



cation, and Guide to the Literature. Pergamon Press, New York and Oxford.

- Corliss, J. O. 1963. Establishment of an International type-slide collection for the ciliate protozoa. *J. Protozool.* 10: (In press.)
- Faure-Fremiet, E., and H. Mugard. 1946. Sur un infusoire hofotriche histophage, *Deltopylum rhabdoides* n.g., n. sp. *Bull. Soc. zool. Fr.* 71: 161-164.
- Furgason, W. H. 1940. The significant cytostomal pattern of the "Glacoma-Colpidium group," and a proposed new genus and species, *Tetrahymena geleii*. *Arch. Protistenk.* 94:224-266.
- Gelei, G. von. 1940. *Cinetochilum* und sein Neuronemensystem. *Arch. Protistenk.* 94:57-79.
- Gelei, J. von. 1935. Eine neue Abänderung der Klein'schen trockenen Silvermethode und das Silberliniensystem von *Glaucoma scintillans*. *Arch. Protistenk.* 84: 446-455.
- Gelei, J. von. 1940. Körperbau und Erregungsleitung bei den Ciliaten. Eine Studie an *Loxocephalus* und einigen anderen Ciliaten. *Arch. Protistenk.* 93:273-316.
- Gelei, J. von & P. Horvath. 1931. Eine nasse Silber-bzw. Goldmethode für die Herstellung der reizleitenden Elemente bei den Ciliaten. *Z. wiss. Mikr.* 48:9-29.
- Holz, G. G., Jr. and J. O. Corliss. 1956. *Tetrahymena setifera* n. sp., a member of the genus *Tetrahymena* with a caudal cilium. *J. Protozool.* 3:112-118.
- Kahl, A. 1930-1935. Urtiere oder Protozoa. I: Wimpertiere oder Ciliata (Infusoria), eine Bearbeitung der freilebenden und ectocommensalen Infusorien der Erde, unter Ausschluss der merinen Tintinidae. In Dahl, F., *Die Tierwelt Deutschlands*. Teil 18 (yr. 1930), 21 (1931), 25 (1932), 30 (1935), 1-886. G. Fischer, Jena.
- Klein, B. M. 1942. Differenzierungsstufen des Silberlinien-oder neroformativen Systems. *Arch. Protistenk.*, 96:1-30.
- Kozloff, E. N. 1946. The morphology and systematic position of a hofotrichous ciliate parasitizing *Deroceras agreste*. *J. Morph.* 79:445-465.
- Schewiakoff, W. 1889. Beiträge zur Kenntniss der hofotrichen Ciliaten. *Bibl. zool.*, 5:1-77.
- Schewiakoff, W. 1893. Ueber die geographische Verbreitung der

Suisswasser-Protozoen. Mem. Acad. imper. Sci. St. Petersburg. (ser. 7), 41:1-201.

Stout, J. D. 1956. *Saprophilus muscorum* Kahl, a tetrahymenial ciliate. *J. Protozoology*. 3:28-30.

Thompson, J. C., Jr., and V. Cone. 1962. A redescription of the hymenostome ciliate *Sathrophilus* (= *Saprophilus*) *muscorum* (Kahl, 1931) Corliss, 1960, with particular attention to the buccal apparatus. *Va. Jour. Sci.*, 14:16-22.